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MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

40. Proposed by F. M. PRIEST, Mona House, St. Loufs, Missouri.

Suppose two cylindrical iron shafts, each 6 inches in diameter and respectively, 20 and 40 feet in height, are both standing perpendicular at the sea level. They start to fall in still air, how long will it require each one to fall to a horizontal position?

Solution by G. B. M. ZERR, A. M., Ph. D., Texarkana, Arkansas-Texas.

Neglecting the atmosphere and supposing the cylinder to revolve about a diameter in the base, we get, if l is the length of an equivalent pendulum, from works on Mechanics the formula for the time of vibration of a pendulum,

$$t = \sqrt{\frac{l}{g}} \int_0^a \frac{d\theta}{\sqrt{\sin^2 \frac{1}{2}a - \sin^2 \frac{1}{2}\theta}}.$$

In this problem a is $180^\circ = \pi$, $\theta = 90^\circ = \frac{1}{2}\pi$.

$$\therefore t = \sqrt{\frac{l}{g}} \int_{\frac{1}{2}\pi}^{\pi} \frac{d\theta}{\cos \frac{1}{2}\theta} = \left[2 \sqrt{\frac{l}{g}} \log. \left\{ \frac{\tan(\frac{1}{4}\pi + \frac{1}{4}a)}{\tan(\frac{1}{4}\pi + \frac{1}{4}\theta)} \right\} \right]_{\theta=\frac{1}{2}\pi}^{a=\pi}$$

$\therefore t = \infty$, which proves that in a perfectly vertical position they will not fall unless moved slightly from this position. Let $a = \pi - \delta$ where δ is very small.

$$\therefore t = 2 \sqrt{\frac{l}{g}} \log. \left\{ \frac{\cot \frac{1}{4}\delta}{\tan \frac{3\pi}{8}} \right\}.$$

Let $\delta = 1'$, l = length of cylinder, b = radius of base.

$\therefore l = (3b^2 + 4l^2)/6l = 13.3349$ feet for first cylinder.

$l = 26.66745$ feet for second cylinder.

$\therefore t = 2(.644328)(3.153498) = 4.0638$ seconds for first cylinder.

$t = 2(.911177)(3.153498) = 5.7468$ seconds for second cylinder.

41. Proposed by WILLIAM SYMMONDS, A. M., Professor of Mathematics and Astronomy, Pacific College, Santa Rosa, California.

A straight inflexible bar of uniform weight and thickness, length m is suspended at the two ends by a string without weight, length $l > m$ passing freely over a peg driven in a perpendicular wall. Describe and analyze the curve traced on the wall by the ends of the hanging bar.